

# Recent Results and Mission Update for the Atmospheric Chemistry Experiment (ACE)

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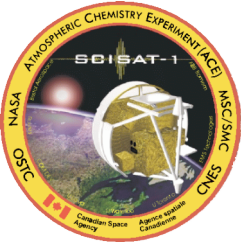
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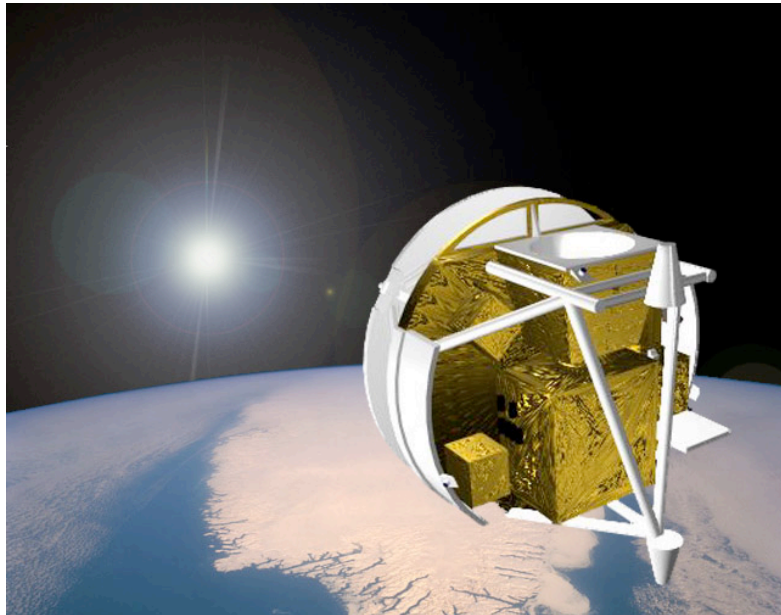
Aura Science Team Meeting - Helsinki, Finland - 13 September 2011



# ACE on SCISAT-1

## Atmospheric Chemistry Experiment (ACE) Satellite Mission:

Mission to measure atmospheric composition: profiles of trace gas species, cloud and aerosol extinction and temperature/pressure



**Launch date:** August 12, 2003

**Orbit:** 74° inclination at 650 km

**Measurement mode:** solar occultation

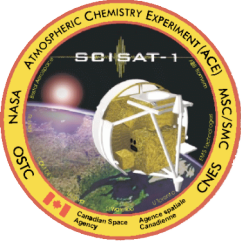
### ACE-FTS:

- FTIR spectrometer, 2-13 microns at 0.02 cm<sup>-1</sup> resolution
- 2-channel visible/NIR imager, 0.525 and 1.02 microns

### MAESTRO:

- dual UV / visible / NIR grating spectrophotometer, 285 to 1030 nm at ~1-2 nm resolution

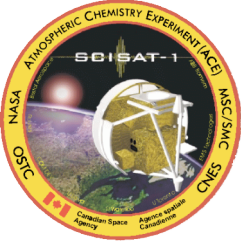
**Pointing:** suntracker in ACE-FTS



# ACE Mission Status

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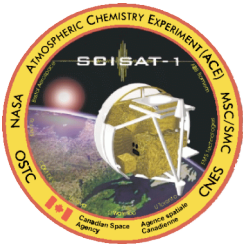
- Now into 9th year in orbit – designed for 2 year lifetime
  - Starting to see some degradation in ACE-FTS performance and MAESTRO continues to “age gracefully”
- Since launch, satellite and instrument operations nominal
  - On 12 September 2011, SCISAT completed its 43,500th orbit!
  - Profiles available for ~70% occultations
  - ~50% of occultations occur in polar regions ( $> 60$  degrees)
- Operation of ACE mission approved until end of March 2012
  - Are discussing continuation plans with CSA



# ACE Data Products

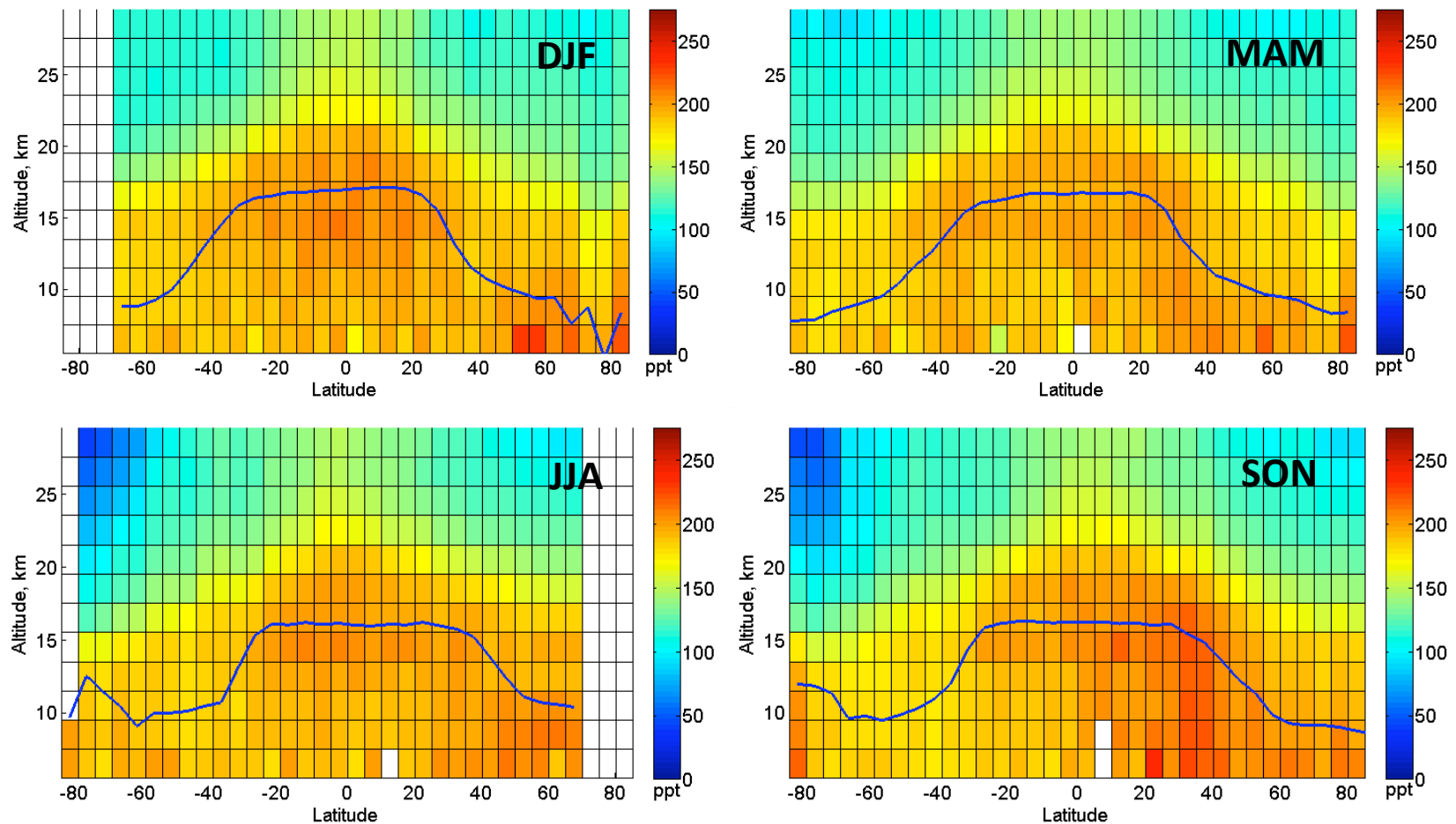
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- ACE-FTS profiles (current version 3.0; previous v2.2+updates):
  - Tracers:  $\text{H}_2\text{O}$ ,  $\text{O}_3$ ,  $\text{N}_2\text{O}$ ,  $\text{NO}$ ,  $\text{NO}_2$ ,  $\text{HNO}_3$ ,  $\text{N}_2\text{O}_5$ ,  $\text{H}_2\text{O}_2$ ,  $\text{HO}_2\text{NO}_2$ ,  $\text{N}_2$
  - Halogen-containing gases:  $\text{HCl}$ ,  $\text{HF}$ ,  $\text{ClONO}_2$ ,  $\text{CFC-11}$ ,  $\text{CFC-12}$ ,  $\text{CFC-113}$ ,  $\text{COF}_2$ ,  $\text{COCl}_2$ ,  $\text{COFCl}$ ,  $\text{CF}_4$ ,  $\text{SF}_6$ ,  $\text{CH}_3\text{Cl}$ ,  $\text{CCl}_4$ ,  $\text{HCFC-22}$ ,  $\text{HCFC-141b}$ ,  $\text{HCFC-142b}$
  - Carbon-containing gases:  $\text{CO}$ ,  $\text{CH}_4$ ,  $\text{CH}_3\text{OH}$ ,  $\text{H}_2\text{CO}$ ,  $\text{HCOOH}$ ,  $\text{C}_2\text{H}_2$ ,  $\text{C}_2\text{H}_4$ ,  $\text{C}_2\text{H}_6$ ,  $\text{OCS}$ ,  $\text{HCN}$  and **pressure / temperature from  $\text{CO}_2$  lines**
  - Isotopologues: Minor species of  $\text{H}_2\text{O}$ ,  $\text{CO}_2$ ,  $\text{O}_3$ ,  $\text{N}_2\text{O}$ ,  $\text{CO}$ ,  $\text{CH}_4$ ,  $\text{OCS}$
  - Research species:  $\text{ClO}$ , acetone, PAN (peroxyacetyl nitrate), etc.
- MAESTRO profiles (validated version 1.2; version 3.0 being tested):
  - $\text{O}_3$ ,  $\text{NO}_2$ , and optical depth (water vapor and aerosol for v3.0)
- IMAGERS profiles (validated version 2.2; version 3.0 being tested):
  - Atmospheric extinction at 0.5 and 1.02 microns (aerosols in v3.0)

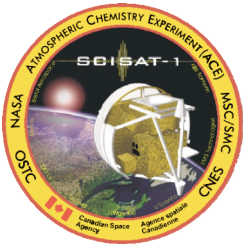


# HCFC-22 Zonal Mean Climatology

- $\text{CHF}_2\text{Cl}$  has 12 year lifetime. It was introduced as replacement for CFC-11 and CFC-12 and is now being phased out

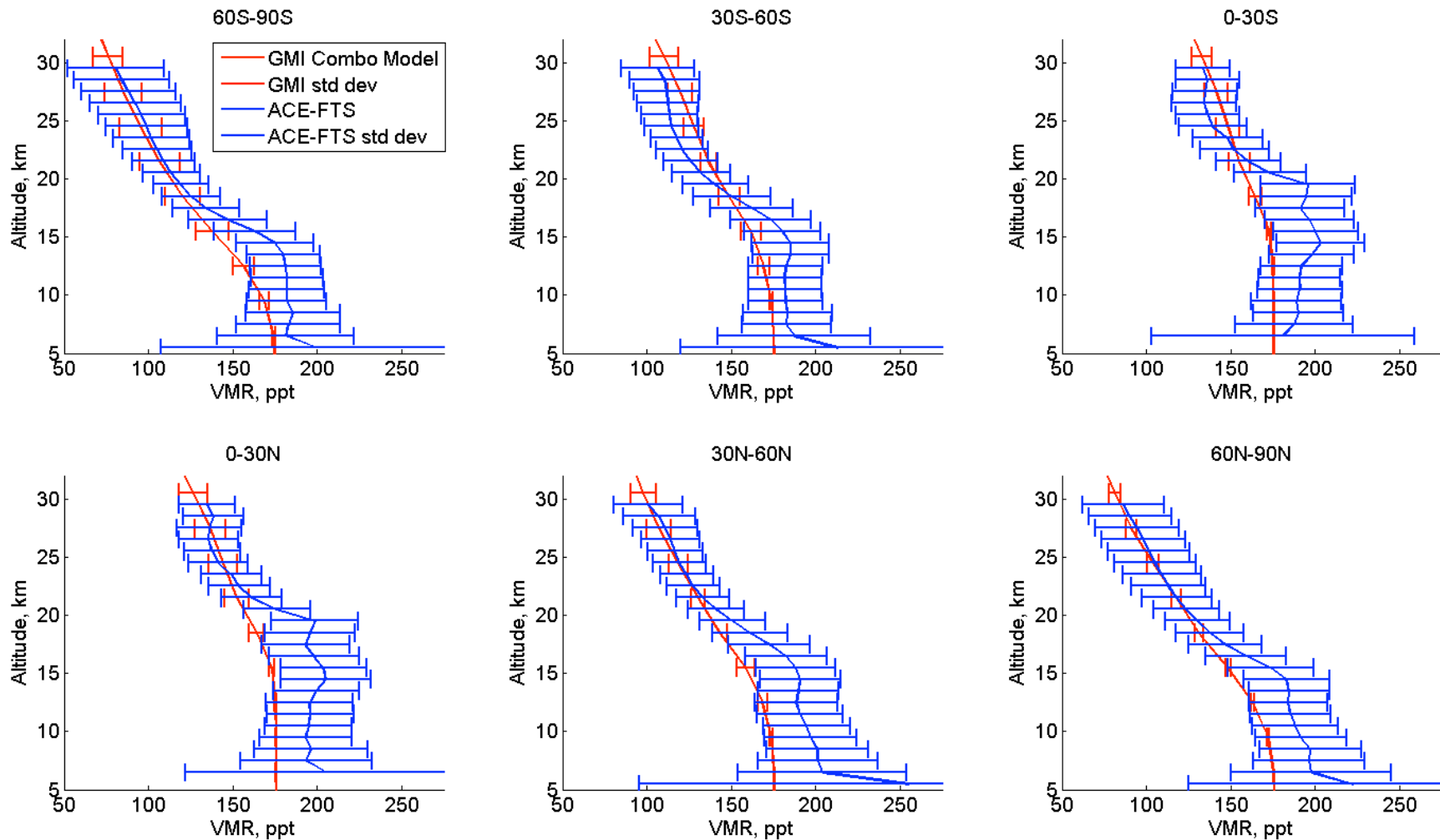


F. Kolonjari, in preparation

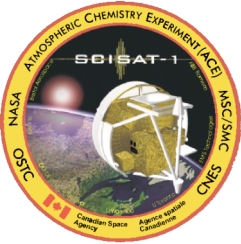


# ACE HCFC-22 vs. GMI Combo Model

- Using MERRA, over similar time periods Jan 2004-May 2011



F. Kolonjari, in preparation

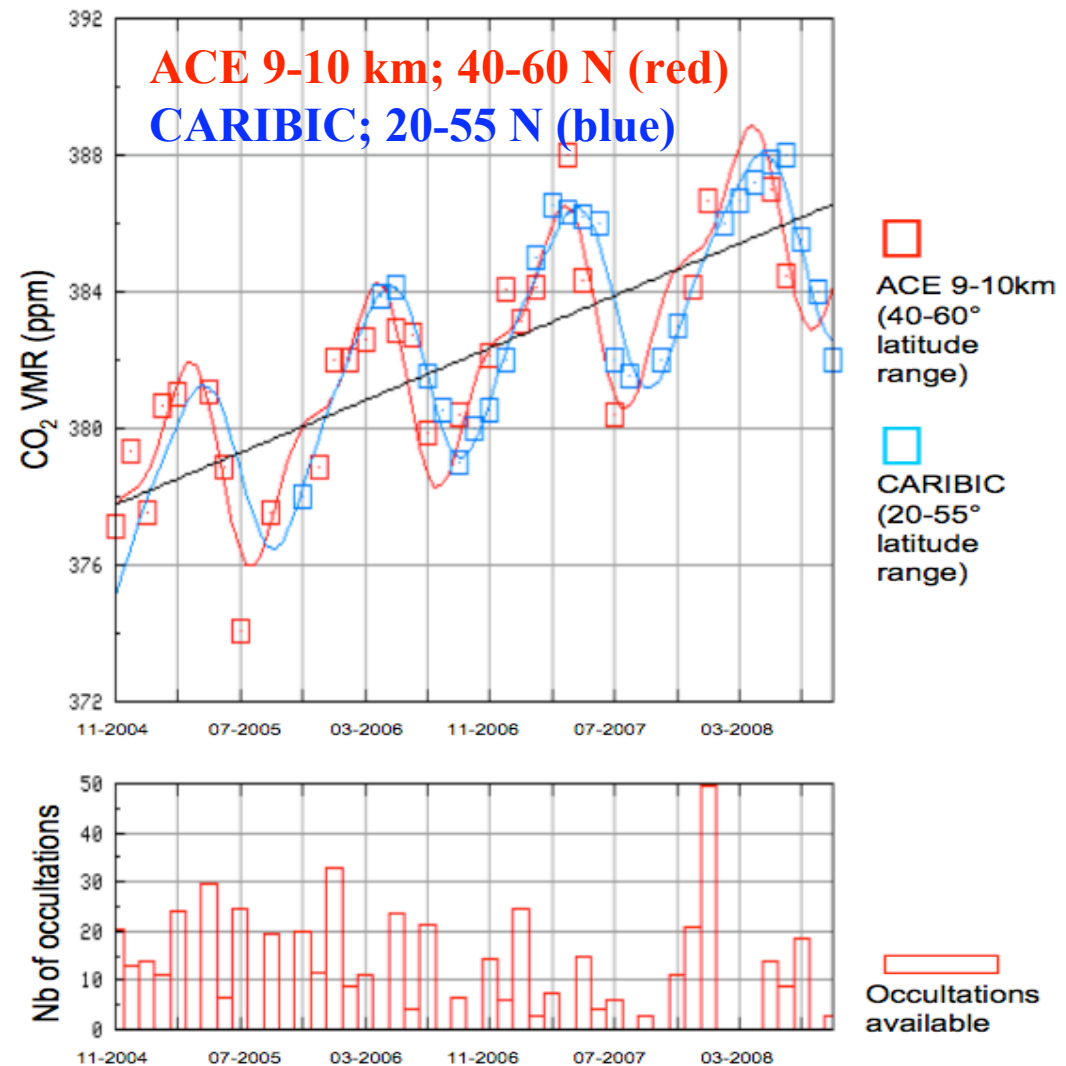


# ACE Monthly CO<sub>2</sub>: 2004 - 2008

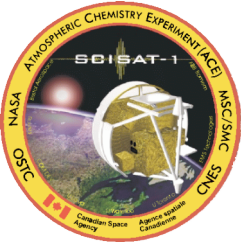
Normal ACE-FTS retrieval uses constant CO<sub>2</sub> VMR to get T, p and tangent heights.

Use N<sub>2</sub> continuum instead and then retrieve CO<sub>2</sub> VMR in 5-25 km altitude range.

Less than 2 ppm offset between ACE and CARIBIC seen







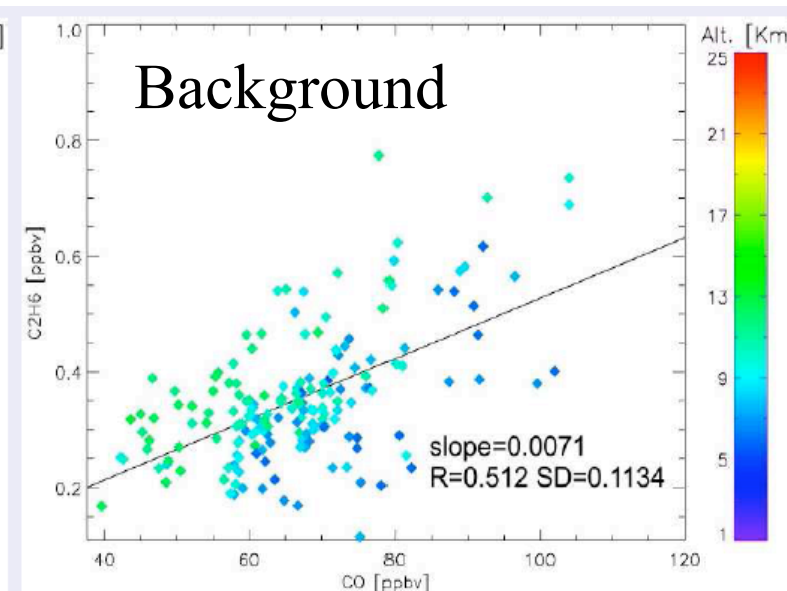
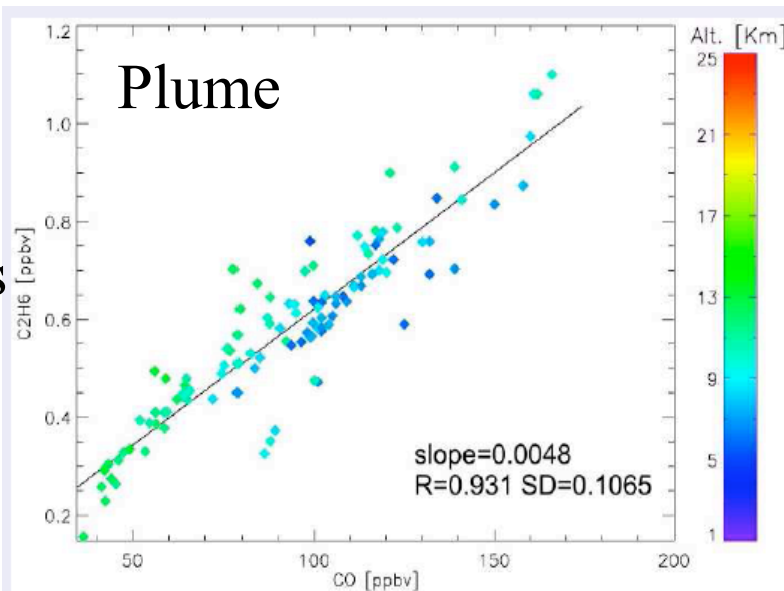
# BORTAS Campaign

- Quantifying the impact of BOReal forest fires on Tropospheric oxidants over the Atlantic using Aircraft and Satellites (PI: Paul Palmer, Edinburgh)
- UK FAAM aircraft flights in 10 July - 3 Aug. 2011 out of Halifax;
- Focus on analysis of satellite data and detailed chemical modelling of fire plumes (in situ sampling, ground-based obs., modelling and satellites)



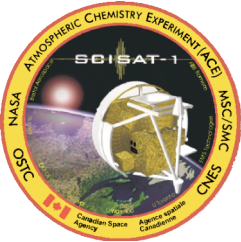


# Examining ACE trace gas - CO correlations in young Boreal plumes in July 2008

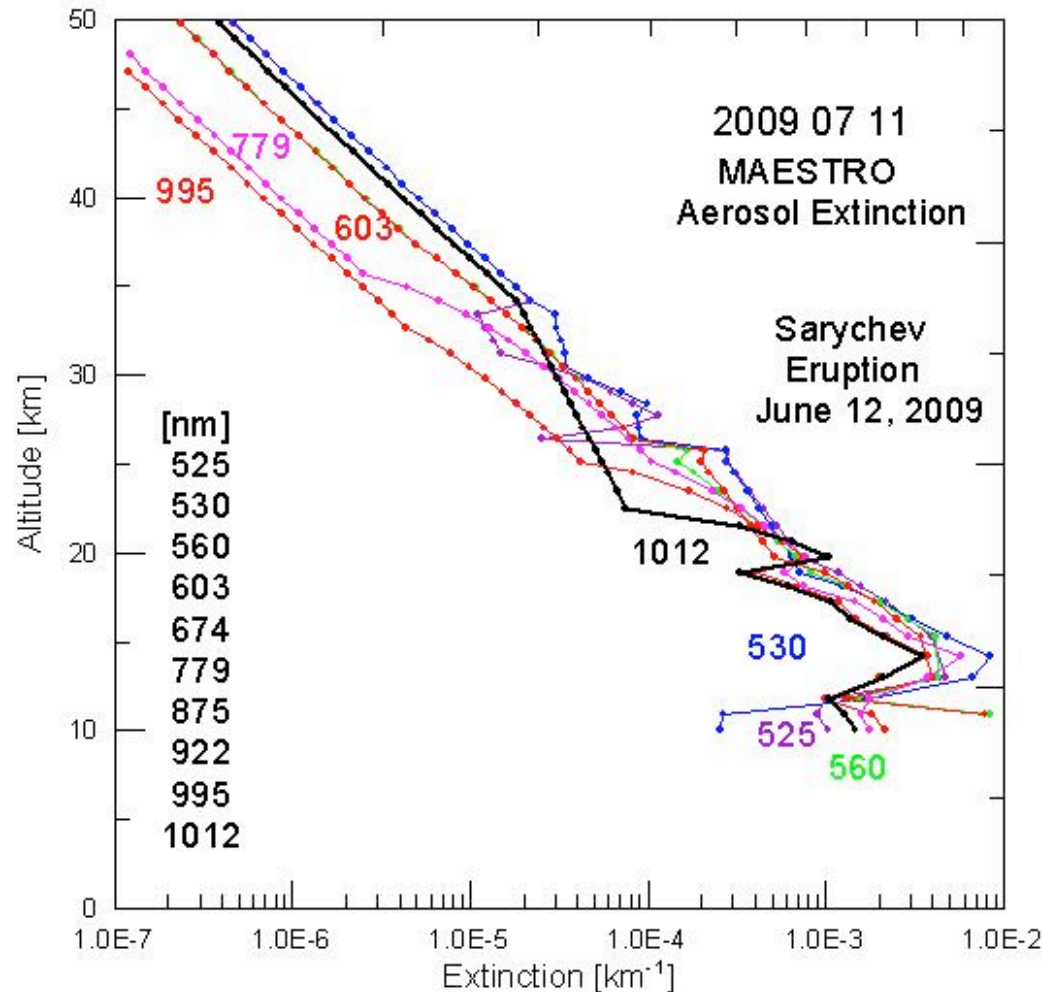


Correlation coefficients (R) of Tracer-CO calcs for various biomass sources – Plumes 2-3 Days Old

Biomass Source	C <sub>2</sub> H <sub>2</sub>	C <sub>2</sub> H <sub>6</sub>	CH <sub>3</sub> OH	CH <sub>4</sub>	H <sub>2</sub> CO	HCN	HCOOH	HNO <sub>3</sub>	N <sub>2</sub> O <sub>5</sub>	NO	NO <sub>2</sub>	O <sub>3</sub>	OCS
Amazon	<b>0.918</b> 0.0014 (0.0360)	<b>0.939</b> 0.0050 (0.0711)	<b>0.937</b> 0.0212 (0.2930)	<b>0.155</b> 0.2311 (51.39)	<b>0.702</b> 0.0009 (0.0289)	<b>0.932</b> 0.0030 (0.0374)	<b>0.885</b> 0.0024 (0.0414)	<b>0.149</b> 0.0006 (0.1444)	<b>0.815</b> 0.0007 (0.0467)	<b>0.296</b> 0.0004 (0.0379)	<b>0.971</b> 0.0014 (0.1031)	<b>-0.896</b> -0.6813 (30.11)	<b>0.478</b> 0.0002 (0.0204)
Congo	<b>0.962</b> 0.0021 (0.0247)	<b>0.942</b> 0.0063 (0.1037)	<b>0.926</b> 0.0192 (0.3399)	<b>0.038</b> 0.0717 (71.45)	<b>0.890</b> 0.0007 (0.0271)	<b>0.953</b> 0.0052 (0.0942)	<b>0.924</b> 0.0027 (0.0923)	<b>-0.301</b> -0.0010 (0.1196)	<b>0.896</b> 0.0007 (0.0794)	<b>0.251</b> 0.0002 (0.0405)	<b>0.201</b> 0.0001 (0.1502)	<b>-0.816</b> -0.5374 (27.78)	<b>0.291</b> 0.0002 (0.0161)
Australia	<b>0.951</b> 0.0014 (0.0178)	<b>0.918</b> 0.0048 (0.0671)	<b>0.840</b> 0.0098 (0.2895)	<b>0.265</b> 0.2300 (69.19)	<b>0.723</b> 0.0012 (0.0354)	<b>0.806</b> 0.0055 (0.0662)	<b>0.859</b> 0.0023 (0.0816)	<b>-0.872</b> -0.0010 (0.0861)	<b>0.867</b> 0.0015 (0.0367)	<b>0.591</b> 0.0004 (0.0094)	<b>-0.831</b> -0.0007 (0.0839)	<b>-0.926</b> -1.3131 (32.11)	<b>0.509</b> 0.0001 (0.0132)
Background	<b>0.442</b> 0.0009 (0.0170)	<b>0.348</b> 0.0032 (0.1109)	<b>0.586</b> 0.0096 (0.1591)	<b>0.026</b> 0.2413 (88.65)	<b>0.303</b> 0.0024 (0.0285)	<b>0.246</b> 0.0009 (0.0500)	<b>0.322</b> 0.0049 (0.0704)	<b>0.197</b> 0.0011 (0.1218)	<b>0.065</b> 0.0004 (0.0625)	<b>-0.128</b> -0.0007 (0.0425)	<b>0.221</b> 0.0027 (0.0967)	<b>-0.326</b> -0.6948 (35.79)	<b>0.046</b> 0.0001 (0.0431)
Canada Boreal	<b>0.719</b> 0.0013 (0.0267)	<b>0.931</b> 0.0048 (0.1065)	<b>0.846</b> 0.0217 (0.6299)	<b>0.095</b> 0.2857 (72.14)	<b>0.832</b> 0.0011 (0.0335)	<b>0.613</b> 0.0013 (0.0354)	<b>0.928</b> 0.0034 (0.1074)	<b>-0.858</b> -0.0121 (0.0906)	<b>0.005</b> 0.0001 (0.0307)	<b>0.888</b> 0.0012 (0.0933)	<b>-0.885</b> -0.0003 (0.1028)	<b>-0.909</b> -2.134 (34.32)	<b>0.019</b> 0.0001 (0.0331)
Background	<b>0.594</b> 0.0012 (0.0172)	<b>0.512</b> 0.0071 (0.1134)	<b>0.109</b> 0.0347 (0.4629)	<b>0.136</b> 2.741 (93.24)	<b>0.274</b> 0.0015 (0.0221)	<b>0.360</b> 0.0005 (0.0724)	<b>0.269</b> 0.0030 (0.0429)	<b>-0.231</b> -0.0084 (0.3884)	<b>0.052</b> 0.0002 (0.0625)	<b>0.209</b> 0.0028 (0.0498)	<b>-0.257</b> -0.0021 (0.1397)	<b>-0.555</b> -2.500 (127.43)	<b>0.160</b> 0.0002 (0.0362)

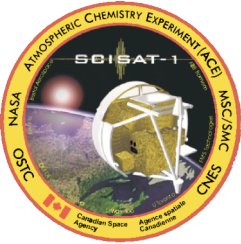


# MAESTRO Aerosol Extinction



- As part of new v3.0 aerosol products, MAESTRO aerosol extinction profiles are being calculated across the VIS band
- Also, Angstrom coefficient profiles are being developed
- Example showing aerosol layer (at ~16 km) from Sarychev eruption

Tom McElroy



# Beyond ACE?

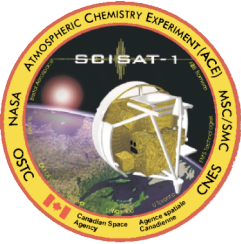
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SAGE III will be deployed on ISS in ~2015 timeframe

- Currently, no missions approved to continue the series of infrared solar occultation measurements

Opportunities being pursued as available - mainly for ISS

- Industrial and science studies for ACE-FTS and next-generation FTS instrument are continuing with CSA
- iATMOS is being proposed to NASA Earth Venture-2 call for ISS deployment (PI: W. Randel, NCAR)
- LOI submitted for ESA call for ISS experiments relevant to Global Climate Change - due in early November 2011



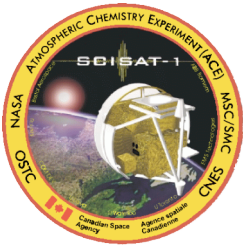
# Summary

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- ACE Instruments and satellite are continuing to function nominally and produce excellent results
- Data being used for scientific and validation studies
  - Reprints available from <http://www.ace.uwaterloo.ca>
  - Validation results published in *Atmos. Chem. Phys.*:  
[http://www.atmos-chem-phys.net/special\\_issue114.html](http://www.atmos-chem-phys.net/special_issue114.html)

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- Natural Sciences and Engineering Research Council of Canada
- Environment Canada
- Canadian Foundation for Climate and Atmospheric Sciences
- Natural Environment Research Council (NERC)



# Angstrom Coefficients

